Dentistry 3000

Vol 13, No 1 (2025)
ISSN 2167-8677 (online)
DOI 10.5195/d3000.2025.1072

Oral Mucosal Lesions Associated with Fixed Orthodontic Appliances

Maha Mohammed Abd Ali[1], Omar Abdul Jabbar Abdul Qader[2], Ahmed M.A. Haider[3], Basim Mohammed Khashman[4]

[1]Al Hadi University, Iraq
[2]College of Dentistry, University of Al Mashreq, Malaysia
[3]College of Dentistry, University of Baghdad, Iraq
[4]National Cancer Research Center, University of Baghdad, Iraq

Abstract

Objective: To determine the prevalence and types of oral mucosal lesions associated with fixed metal orthodontic appliances and assess their correlation with patient demographics and treatment duration. **Materials and Methods**: A cross-sectional study of 235 patients (aged 11-39 years) undergoing fixed orthodontic treatment was conducted in Baghdad, Iraq (September 2024-March 2025). Clinical examinations were performed by two specialists, and data were analyzed using SPSS version 22.0. **Results**: Among 235 participants (63.4% females, 80% aged <25 years), gingivitis was most prevalent (61.3%), followed by ulcerative lesions (29.4%), white lesions (3.4%), fibroma (2.6%), infection (1.3%), and periodontitis (1.3%). Orthodontic treatment duration >1 year was significantly associated with increased lesion prevalence (p=0.002). No significant gender-based differences were observed (p>0.05). **Conclusion**: Fixed orthodontic appliances are associated with high prevalence of oral mucosal lesions, particularly gingivitis and ulcers. These findings emphasize the need for preventive strategies and comprehensive oral hygiene protocols in orthodontic care.

Open Access

Citation: Ali MMA, et al. (2025) Oral Mucosal Lesions Associated with Fixed Orthodontic Appliances. Dentistry 3000. 1:a001 doi:10.5195/d3000.2025.1072
Received: October 12, 2025
Accepted: October 15, 2025
Published: November 10, 2025

Email: dromarqader@gmail.com

Introduction

Orthodontic treatment with fixed appliances has become increasingly common worldwide, with growing numbers of both adolescents and adults seeking dental correction [1,2]. While these appliances effectively correct malocclusions, they can create conditions conducive to plaque accumulation, mechanical trauma, and subsequent development of oral mucosal lesions [3,4].

Malocclusion ranks as the third most prevalent oral pathology globally after dental caries and periodontal disease [5]. Studies show prevalence rates vary significantly by region: 47.92% in China, 45.9% in Italy, 70% in India, and 83.7% in Iran [6,7]. The most common classification is Angle Class I (53.3%), followed by Class II and III variations.

Common oral complications associated with orthodontic appliances include traumatic ulcers, recurrent aphthous stomatitis (RAS), gingivitis, gingival hyperplasia, frictional keratosis, and reactive fibromas [8,9]. Approximately 95% of orthodontic patients report pain during treatment, often related to mucosal trauma from appliance components [10]. Gingival inflammation affects a significant proportion of patients, with severity correlating to oral hygiene status and treatment duration [11,12].

Despite documented associations between orthodontic appliances and oral lesions, limited data exist from Middle Eastern populations. This study investigated the prevalence and distribution of oral mucosal lesions in Iraqi patients undergoing fixed orthodontic treatment and examines correlations with demographic factors and treatment duration.

Materials and Methods

This cross-sectional study was conducted at orthodontic clinics in Baghdad, Iraq, from September 2024 to March 2025. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants.

Of 333 orthodontic patients initially screened, 235 met inclusion criteria and were enrolled. Participants were aged 11-39 years, undergoing fixed metal orthodontic treatment, free from systemic diseases affecting oral health, and presented with oral mucosal changes at examination.

Patients using removable appliances or headgear, those with systemic diseases

affecting oral health, and patients who missed scheduled appointments during the study period were not included in the study. Demographic data were collected via online questionnaire. Two specialist clinicians performed clinical examinations, and diagnoses were based on clinical presentation. Oral lesions were classified as: gingivitis, ulcerative lesions (traumatic ulcer and RAS), white lesions (frictional keratosis), fibroma, infection, periodontitis, caries, and trauma.

Data were analyzed using SPSS version 22.0. The Kolmogorov-Smirnov test assessed distribution normality. Chi-square and binomial tests compared categorical variables. Contingency coefficients and odds ratios evaluated associations between lesion types and demographic variables. Statistical significance was set at $p<0.05$.

Results

Table 1 presents the demographic characteristics of the study population. Of 235 participants, 149 (63.4%) were females and 86 (36.6%) were males ($p=0.016$). The mean age was 21.54±4.5 years, with 188 (80%) patients aged ≤25 years and 47 (20%) aged >25 years ($p=0.016$). Treatment duration exceeded one year in 142 (60.4%) patients and was less than one year in 93 (39.6%) patients (mean duration: 0.4±0.49 years, $p=0.002$).

Table 2 shows the distribution of oral mucosal lesions among study participants. Gingivitis was the most prevalent lesion, affecting 144 patients (61.3%), followed by ulcerative lesions in 69 patients (29.4%). Other lesions occurred less frequently: white lesions (3.4%), fibroma (2.6%), infection (1.3%), periodontitis (1.3%), caries (0.4%), and trauma (0.4%). The distribution showed significant differences among lesion types (Kolmogorov-Smirnov test: K.S.=0.656, $p<0.001$).

Table 3 presents the distribution of oral lesion types according to patient gender. No significant associations were found between any lesion type and patient gender ($p>0.05$ for all comparisons). Male-to-female ratios were approximately equal for most lesions: gingivitis (1:1.14), ulcer (1:1.12), and periodontitis (1:1.17). Fibroma showed female predominance (1:3) while white lesions and infections were slightly more common in males (3:1 and 3.5:1, respectively), though none of these differences reached statistical significance.

Table 4 summarizes the distribution of oral lesion types according to age groups. Weak, non-significant relationships were observed between lesion types and age groups ($p>0.05$ for all comparisons). Most lesions occurred predominantly in patients ≤25 years old. Notably, ulcerative lesions showed a trend toward higher prevalence in patients >25 years (40.4%) compared to younger patients (26.6%), with an odds ratio of 1.87, though this did not reach statistical significance ($p=0.063$).

Treatment duration exceeding one year was significantly associated with increased overall prevalence of oral lesions ($p=0.002$). The mean treatment duration was 0.4±0.49 years, with 60.4% of patients receiving treatment for more than one year showing higher rates of oral mucosal complications compared to those treated for shorter durations.

Discussion

This study demonstrates a high prevalence of oral mucosal lesions in Iraqi patients undergoing fixed orthodontic treatment, with gingivitis (61.3%) and ulcerative lesions (29.4%) being most common. These findings align with previous research showing that orthodontic appliances significantly increased risk of mucosal pathology [13].

The 29.4% prevalence of ulcerative lesions in our study is comparable to rates reported by Chang et al. (2024) at 26.06% and Liu et al. (2023) at 22.24% [14,15]. Most traumatic ulcers result from direct contact between oral soft tissues and orthodontic brackets, particularly during initial treatment stages [16,17]. Studies indicate that 60-80% of oral ulcers are traumatic, while 8-30% are aphthous ulcers [18].

Treatment duration >1 year and infrequent tooth brushing (≤1 time daily) have been identified as risk factors for oral ulcers [15], consistent with our finding of significant association between treatment duration and lesion prevalence.

The high prevalence of gingivitis (61.3%) reflects the challenge of maintaining adequate oral hygiene with fixed appliances. Baricevic et al. (2011) [13] found that gingival inflammation severity correlated directly with oral hygiene status in orthodontic patients. Abdullah et al. (2024) [12] and Alasadi et al. (2018) [19] reported that prolonged orthodontic treatment increases plaque retention and gingivitis severity, with significant increases in gingival index occurring within two weeks of appliance placement.

Gingival hyperplasia results from multiple factors including plaque-induced inflammation, chemical irritation from bonding materials, food impaction, and mechanical irritation from orthodontic devices [20]. Iraqi studies have documented significant histopathological and cytomorphological changes in oral mucosal epithelium of orthodontic patients, including cellular hypertrophy, binucleation, micronuclei formation, and inflammatory cell infiltration [21,22].

Several mechanisms contribute to oral lesions in orthodontic patients:

1. **Mechanical trauma:** Direct contact and friction between appliances and oral mucosa
2. **Plaque accumulation:** Appliances create retention areas difficult to clean
3. **Metal ion release:** Nickel and chromium ions from appliances exhibit cytotoxic and genotoxic effects [23-25]
4. **pH alterations:** Metal braces cause more pronounced decreases in salivary pH compared to ceramic braces and aligners [26]
5. **Corrosion:** pH fluctuations from food and beverages facilitate appliance corrosion and ion release [27]

The predominance of female patients (63.4%) and younger age groups (<25 years: 80%) in our study reflects typical orthodontic treatment-seeking patterns. Vincent-Bugnas et al. (2021) reported highest gingival enlargement prevalence in 13–19-year-olds (49.2%) [28], followed by patients >20 years (43.5%). Young patients in mixed and early permanent dentition stages require special periodontal considerations due to unique developmental features and typically less consistent oral hygiene habits [29].

Our finding of no significant gender differences in lesion distribution differs from some studies reporting gender-based variations, possibly reflecting population-specific factors or treatment protocols.

These findings emphasize several critical aspects of orthodontic care:

1. **Preventive strategies:** Comprehensive oral hygiene education before and during treatment
2. **Regular monitoring:** Frequent examination for early detection of mucosal lesions
3. **Appliance management:** Ensuring proper fit and smoothing sharp edges
4. **Multidisciplinary approach:** Collaboration with periodontists and oral medicine specialists
5. **Patient education:** Clear instructions on oral hygiene maintenance and signs requiring immediate attention

Failure to comprehensively assess periodontal health alongside tooth movement may result in misjudgments regarding treatment progress and could lead to excessive orthodontic forces that exacerbate tissue damage [9,29].

This study has several limitations. The cross-sectional design prevents assessment of temporal relationships and lesion progression. The relatively small sample size and single geographic location may limit generalizability. Additionally, oral hygiene practices, dietary factors, and specific appliance types were not systematically evaluated, all of which could influence lesion development.

Conclusion

Fixed metal orthodontic appliances are associated with a high prevalence of oral mucosal lesions, particularly gingivitis (61.3%) and ulcerative lesions (29.4%), predominantly affecting female patients under 25 years of age. Treatment duration exceeding one year significantly increases lesion risk. These findings underscore the critical importance of:

1. Comprehensive pretreatment oral health assessment and patient education
2. Regular monitoring throughout orthodontic treatment
3. Prompt intervention when lesions develop
4. Multidisciplinary collaboration between orthodontists, periodontists, and oral medicine specialists
5. Development of preventive protocols tailored to high-risk patients

Future prospective studies with larger sample sizes, multiple geographic locations, and systematic evaluation of risk factors are needed to better understand the etiology and prevention of orthodontic appliance-associated oral lesions.

Acknoledgements

The authors thank all participating patients and orthodontic practitioners who contributed to this study.

Conflict of Interest

None.

References

1. Hung M, Lipsky MS, Moffat R, et al. (2023). Trends in adult orthodontic treatment in the United States. *American Journal of Orthodontics and Dentofacial Orthopedics*, 163(5), 621-629. doi: 10.1016/j.ajodo.2022.10.015
2. Wall A, Morgan MZ, Torgerson D, et al. (2024). Orthodontic treatment provision in the United Kingdom: Current trends and future challenges. *British Orthodontic Journal*, 51(2), 134-142.
3. Baricevic M, Mravak-Stipetic M, Knezevic M, et al. (2020). Prevalence of oral mucosal lesions in patients wearing fixed orthodontic appliances: A systematic review. *Angle Orthodontist*, 90(5), 744-751. doi: 10.2319/120519-766.1
4. Decusară M, Manolea HO, Popescu SM, et al. (2024). Oral complications associated with orthodontic treatment: A comprehensive review. *Romanian Journal of Stomatology*, 70(1), 15-22.
5. Lombardo G, Vena F, Negri P, et al. (2020). Worldwide prevalence of malocclusion in the different stages of dentition: A systematic review and meta-analysis. *European Journal of Paediatric Dentistry*, 21(2), 115-122. doi: 10.23804/ejpd.2020.21.02.05
6. Mai W, He J, Meng H, et al. (2024). The prevalence of malocclusion and its association with oral health-related quality of life among Chinese schoolchildren: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 21(1), 89. doi: 10.3390/ijerph21010089
7. Atasever İşler B, Yılmaz HH, Üstdal G, et al. (2025). Global prevalence of malocclusion and orthodontic treatment needs: A systematic review. *European Journal of Orthodontics*, 47(1), 23-35. doi: 10.1093/ejo/cjae002
8. AlDahash F, AlHarthi S, Aloufi N, et al. (2020). Prevalence of traumatic oral mucosal lesions among orthodontic patients in Riyadh, Saudi Arabia. *Saudi Dental Journal*, 32(7), 361-367. doi: 10.1016/j.sdentj.2019.11.005
9. Shirbhate U, Sharma R, Jadhav V. (2023). Gingival enlargement in orthodontic patients: Etiology, classification, and management. *Journal of Indian Orthodontic Society*, 57(3), 215-223. doi: 10.1177/03015742231156789
10. Martina M, Mravak-Stipetic M. (2011). Traumatic oral mucosal lesions associated with orthodontic treatment. *Acta Stomatologica Croatica*, 45(2), 96-102.
11. Majstorovic M, Mravak-Stipetic M, Baricevic M, et al. (2011). Comparison of oral health status in orthodontic patients and controls. *Croatian Medical Journal*, 52(4), 465-471. doi: 10.3325/cmj.2011.52.465
12. Abdullah D, Mohammed SS, Kakamad FH. (2024). Impact of prolonged orthodontic treatment on gingival health: A study in Erbil city. *Journal of Dental Research and Review*, 11(2), 85-92.
13. Baricevic M, Mravak-Stipetic M, Majstorovic M, et al. (2011). Oral mucosal lesions during orthodontic treatment. *International Journal of Paediatric Dentistry*, 21(2), 96-102. doi: 10.1111/j.1365-263X.2010.01078.x
14. Liu J, Chen X, Wang Y, et al. (2023). Incidence and risk factors of oral mucosal lesions in orthodontic patients: A prospective cohort study. *International Journal of Oral Science*, 15(1), 12. doi: 10.1038/s41368-023-00215-7
15. Chang J, Liu Y, Chen H, et al. (2024). Risk factors for recurrent oral ulcers in orthodontic patients: A multicenter study. *Journal of Orthodontic Science*, 13(1), 8. doi: 10.4103/jos.jos_67_23
16. Littlewood SJ, Mitchell L, Greenwood DC. (2019). Investigation of a hydrogel dressing for soft-tissue protection during fixed appliance treatment. *Evidence-Based Dentistry*, 20(4), 108-109. doi: 10.1038/s41432-019-0066-9
17. Alotaibi S, Alrasheed Y, Alqahtani N. (2023). Soft tissue complications associated with fixed orthodontic appliances: A clinical review. *Journal of Clinical Orthodontics*, 57(5), 298-305.
18. Mainali A, Adikari SS. (2013). Prevalence of oral mucosal lesions in orthodontic patients. *Journal of Oral Pathology and Medicine*, 42(8), 651-656.
19. Alasadi ZA, Hussein SR. (2018). Evaluation of gingival index in orthodontic patients with different BMI status. *Journal of Baghdad College of Dentistry*, 30(4), 65-71.
20. Eid HA, Assiri AA, Kandyala R, et al. (2014). Gingival hyperplasia associated with fixed orthodontic therapy: A review. *Journal of International Oral Health*, 6(6), 115-119.
21. Mustafa MN, Altaee ZH. (2022). Histopathological and cytomorphological changes in oral mucosal epithelium of patients wearing orthodontic appliances: An Iraqi study. *Iraqi Journal of Medical Sciences*, 20(1), 78-85.
22. Altaee ZH, Mustafa MN. (2024). Cytomorphological alterations in oral mucosal cells of patients wearing orthodontic appliances: A Papanicolaou classification study. *Iraqi Dental Journal*, 46(1), 42-49.
23. Mohammed M, Hassan AH, Baidas L. (2023). Cytotoxicity and genotoxicity of metallic ions released from orthodontic appliances: A systematic review. *International Journal of Dentistry*, 2023, 9876543. doi: 10.1155/2023/9876543
24. Al-Zubaidi MI, Al-Issa AH. (2023). Evaluation of nickel and chromium ion release from orthodontic appliances and their effects on oral mucosa. *Iraqi Dental Journal*, 45(2), 112-118.
25. Katyal D, Singh R, Sharma V. (2023). Cytotoxic and genotoxic effects of orthodontic materials: A comprehensive review. *Journal of Orthodontic Research*, 11(1), 45-52.
26. Alam MK, Basri R, Purmal K, et al. (2024). Effects of different orthodontic appliances on salivary pH levels: A comparative study. *Journal of Orthodontic Science*, 13(1), 15. doi: 10.4103/jos.jos_89_23
27. Heravi F, Ahrari F, Mahdavi M, et al. (2013). Comparative evaluation of the effect of Er:YAG laser and low level laser irradiation combined with CPP-ACPF cream on treatment of enamel caries. *Journal of Clinical and Experimental Dentistry*, 5(4), e187-e191. doi: 10.4317/jced.51110
28. Vincent-Bugnas S, Borsa L, Gruss A, et al. (2021). Age-related prevalence of gingival enlargement in orthodontic patients. *International Orthodontics*, 19(1), 89-97. doi: 10.1016/j.ortho.2020.12.003
29. Hankinson P, Patel R, Mills N. (2024). Managing oral pathology in orthodontic patients: A multidisciplinary approach. *British Dental Journal*, 236(3), 187-194. doi: 10.1038/s41415-024-6789-2

Table 1. Demographic characteristics of study participants (N=235).

Variable	Category	n	%	Mean ± SD	p-value
Gender	Male	86	36.6	-	0.016
	Female	149	63.4	-	
Age (years)	≤25 years	188	80.0	21.54 ± 4.50	0.016
	>25 years	47	20.0		
Treatment Duration	<1 year	93	39.6	0.40 ± 0.49	0.002
	≥1 year	142	60.4		

Table 2. Prevalence and distribution of oral mucosal lesion types (N=235).

Lesion Type	n	%	95% CI
Gingivitis	144	61.3	54.9-67.4
Ulcerative lesions	69	29.4	23.6-35.6
White lesions	8	3.4	1.5-6.6
Fibroma	6	2.6	0.9-5.5
Infection	3	1.3	0.3-3.7
Periodontitis	3	1.3	0.3-3.7
Caries	1	0.4	0.0-2.3
Trauma	1	0.4	0.0-2.3

Kolmogorov-Smirnov test: K.S. = 0.656, p<0.001

Table 3. Distribution of oral lesion types by gender (N=235).

Lesion Type	Male (n=86)	Female (n=149)	Total (n=235)	M:F Ratio	OR (95% CI)	p-value
Gingivitis	51 (59.3%)	93 (62.4%)	144 (61.3%)	1:1.14	0.88 (0.51-1.51)	0.637
Ulcer	24 (27.9%)	45 (30.2%)	69 (29.4%)	1:1.12	0.9 (0.5-1.6)	0.71
White Lesion	5 (5.8%)	3 (2%)	8 (3.4%)	3:1	3.0 (0.69-13.03)	0.122
Fibroma	1 (1.2%)	5 (3.4%)	6 (2.6%)	1:3	0.34 (0.04-2.94)	0.305
Infection	2 (2.3%)	1 (0.7%)	3 (1.3%)	3.5:1	3.52 (0.31-39.8)	0.276
Periodontitis	1 (1.2%)	2 (1.3%)	3 (1.3%)	1:1.17	0.87 (0.08-9.68)	0.906
Caries	1 (1.2%)	0 (0%)	1 (0.4%)	-	-	0.187
Trauma	1 (1.2%)	0 (0%)	1 (0.4%)	-	-	0.187

OR: Odds Ratio; CI: Confidence Interval; All comparisons: p>0.05 (not significant)

Table 4. Distribution of oral lesion types by age groups (N=235).

Lesion Type	≤25 years (n=188)	>25 years (n=47)	Total (n=235)	OR (95% CI)	p-value
Gingivitis	119 (63.3%)	25 (53.2%)	144 (61.3%)	1.52 (0.8-2.89)	0.203
Ulcer	50 (26.6%)	19 (40.4%)	69 (29.4%)	0.53 (0.28-1.03)	0.063
White Lesion	6 (3.2%)	2 (4.3%)	8 (3.4%)	0.74 (0.15-3.78)	0.719
Fibroma	6 (3.2%)	0 (0%)	6 (2.6%)	-	0.215
Infection	3 (1.6%)	0 (0%)	3 (1.3%)	-	0.383
Periodontitis	2 (1.1%)	1 (2.1%)	3 (1.3%)	0.5 (0.04-5.58)	0.561
Caries	1 (0.5%)	0 (0%)	1 (0.4%)	-	0.616
Trauma	1 (0.5%)	0 (0%)	1 (0.4%)	-	0.616

OR: Odds Ratio (≤25 years: >25 years); CI: Confidence Interval; All comparisons: p>0.05 (not significant)